# CHLOROPHYLL CONTENT VARIABILITY IN DIFFERENT SUGARBEET CROP CULTIVARS

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**Introduction**

Measurement of chlorophyll content with portable meters is an easy way to quantify crop nutrient status, but meter readings are affected by different factors (Martinez and Guiamet, 2004), among which cultivar plays an important role (Chapman and Barreto, 1997). The aim of this work was to study the effect of crop cultivar on chlorophyll readings and to study the relationship of chlorophyll content with yield, quality and other eco-physiological and biochemical parameters.

**Materials and Methods**

A trial was carried out in Duero Basin (Burgos province, Spain) during year 2006. Eight sugarbeet cultivars from different commercial seed manufacturers were tested, ensuring enough genotypic variability between them. Agricultural practices were carried out by farmers according to AIMCRA research staff recommendations and control. Sowing and harvest operations were done by researchers. Trial layout was randomized blocks with four replicates. Plot size was 11 $m^2$ (3 crop rows 7.33 m length). Twenty young fully expanded leaves per elemental plot were collected in five sampling dates during crop growth cycle. Chlorophyll content was measured in each leaf with two different equipments: SPAD-502 of Minolta and CCM-200 of Opti-Sciences. Photosynthetic active radiation (PAR) intercepted and reflected by crop canopy were also measured at each sampling date (with a LI-COR line quantum sensor). In the laboratory chlorophyll a and b were extracted and measured with a spectrophotometer; leaf colour was determined with a Konica-Minolta CR – 200 device, nitrogen content was analysed in oven-dried samples by Kjeldalh method and specific leaf weight was computed as the ratio of leaf dry weight and leaf area. Root yield and quality were quantified at harvest.

**Results**

There was a significant effect of crop cultivar on chlorophyll readings (Fig. 1). There were three different groups of cultivars, especially three months after sowing, at the period which crop canopy is growing quickly. These differences were not completely eliminated taking into account specific leaf weight (Fig. 1), as reported for maize by Chapman and Barreto (1997). When chlorophyll readings are going to be used in fertilization decision support a normalized value must be taken into account, and the use of an over-fertilizer band is a recommended option (Piekielek et al., 1995). Data from the two commercial devices used were highly correlated. Chlorophyll showed a high positive correlation with canopy reflected PAR, but there was no consistent relation with the other parameters. It was observed an increasing amount of reflected photosynthetic solar radiation by the crop canopy in those cultivars with a higher value of chlorophyll reading. This pattern may be related with the relative proportion of carotenoids and total chlorophyll, in order to increase protection against photooxidation (Demming-Adams and Adams, 1996).

A quadratic relationship was found between chlorophyll readings and sugar yield (Fig. 2). The determination coefficient ($R^2$) was increasing along the crop growth cycle. There was a maximum value of sugar yield for a given chlorophyll reading, that should be used for crop breeding, as a higher content does not imply a higher yield, due to the energy requirements of chlorophyll biosynthesis (Bloom et al., 1985). Furthermore, when more chlorophyll is synthesized per unit of available N in leaves (ratio of chlorophyll reading by leaf nitrogen), this element should become limiting for the synthesis of other N-based plant macromolecules and, consequently, it should limit also final crop yield (Fig. 2). By the other hand, there was not a consistent relation between chlorophyll readings and root quality parameters in the studied cultivars.

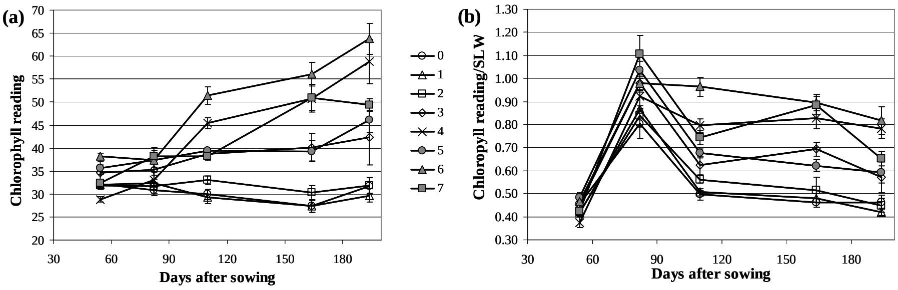


Fig. 1. Chlorophyll meter readings of the eight studied sugarbeet cultivars: (a) Value of the CCM-200 device readings along the crop growth cycle; (b) Value of chlorophyll readings corrected by the specific leaf weight (SLW). (± Standard error of the mean values is plotted as vertical bars).

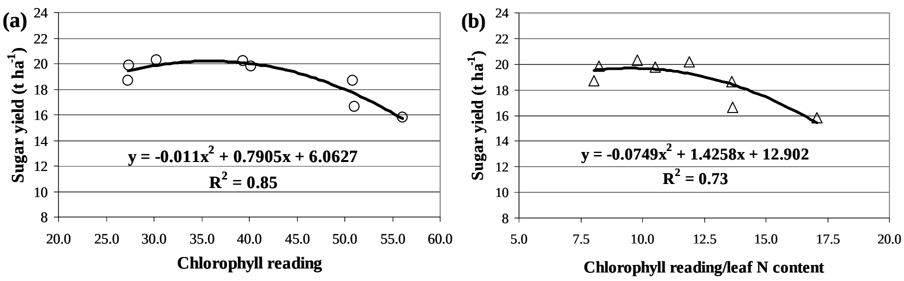


Fig. 2. Relationship between chlorophyll in leaves and sugar yield at harvest: (a) Chlorophyll readings in the eight cultivars at 164 days after sowing; (b) Ratio of chlorophyll reading by leaf nitrogen content in the eight cultivars at 110 days after sowing.

## Conclusions

Chlorophyll content was affected by sugarbeet cultivar, and the reading value was not completely corrected using the specific leaf weight, so cultivar variability should be taken into account when practical use will be done. However, chlorophyll meter readings of the two devices tested were highly correlated. Above a certain threshold, an increment of chlorophyll does not imply a higher yield, a fact that should be taken into account in crop breeding, and also the ratio of chlorophyll reading by leaf nitrogen.

## References

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